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United States
Department of
Agriculture

Forest Service

Forest
Products
Laboratory

Progress Through Wood Research

The Forest Products Laboratory Past, Present, and Future

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Forest Products Laboratory 1910 75th 1985 ANNIVERSARY

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Abstract

This report contains speeches made at the general assembly and banquet of the Forest Products Laboratory's 75th Anniversary celebration on June 4, 1985. It highlights the significance of the Laboratory and presents the speakers' view of the future for forestry and wood products research.

Keywords: FPL 75th Anniversary, 75th general assembly presentations, 75th banquet presentations, FPL history, Gifford Pinchot, wood utilization research, wood technology.

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Foreword

It is with pleasure that I present to you here a selection of papers given by invited speakers at the 75th Anniversary of the Forest Products Laboratory on June 4, 1985. That celebration marked 75 years of wood research that has led to better forest management and more effective use of the wood resource. It brought to our Laboratory many friends and colleagues from academia, industry, and government and offered us all a chance to reflect on past achievements and look to new challenges.

We are grateful to the many people who made this celebration a success. The active role that academia, especially the University of Wisconsin, and other government agencies played in this event signifies their commitment to the Forest Products Laboratory and wood research. These people and organizations, along with our colleagues in industry, remain a cornerstone of our program. We extend special appreciation to the following organizations for their generous gifts symbolizing years of dedication and support for our research: National Forest Products Association, American Paper Institute, Technical Association of the Pulp and Paper Industry, Canadian Wood Council, FORINTEK, National Association of State Foresters, American Institute of Timber Construction, American Plywood Association, Hardwood Research Council, American Wood Preservers' Association, American Society of Civil Engineers, Society of American Wood Preservers, Southern Forest Products Association, Southern Pine Inspection Bureau, Forest Products Research Society, American Forestry Association, Society of American Foresters, Society of Wood Science and Technology, and the American Society for Testing and Materials.

These papers represent only a few of the remarks made during the 2-day celebration. Through them I anticipate you will gain a perspective on the significance of our past 75 years and the visions that we share with other wood researchers for the next 75 years.

It is my hope that this document will give you an insight into our history and that you will use this reference as a reminder of the importance of wood products research--a reminder of the milestones we can achieve through continued cooperative efforts.

Respectfully,

John R. Erickson
Director, Forest Products Laboratory
December 1985

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General Assembly Presentations

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Introductory Remarks

Herbert O. Fleischer, Director (retired)

Forest Products Laboratory, Madison, WI

Today we celebrate the Diamond Anniversary of the Forest Products Laboratory, a part of the Forest Service, U.S. Department of Agriculture, that has operated in Madison in cooperation with the University of Wisconsin.

The 75th anniversary in the history of any human venture is a date to remember. It is a date when one may take a few hours from the day-to-day routine to think about greater things connected with the celebrant. It is truly a time for introspection, for retrospection, and for prospection; or, if you prefer the synonym, for "prospecting"--prospecting in our case for the gold that still lies hidden in our Nation's most valuable renewable resource--wood.

I think back many years to remember traveling south through Oregon on Highway 99 with Archie Knauss, a wood utilization expert then attached to the Pacific Northwest Forest Experiment Station. As we crested a hill north of Eugene, which was then probably the country's biggest lumber-producing city, we saw over 60 sawmills stretched out before us. I shall never forget Archie's remark as he waved his arm from horizon to horizon, "Herb, from this hill you can see more woodwaste burners than anywhere else in the world."

As you know, the Forest Products Laboratory (FPL) served as a catalyst to eliminate those waste burners which used to consume 50 percent of the wood that came from the forest to the mill. Through the application of advanced technology, developed through research, the volume of waste generated in the sawing of lumber at modern sawmills has been reduced by more than 15 percent, and the rest is now mostly made into pulp and paper products and glued composite panels of various kinds. The end result is that the Nation's valuable forest resources are stretched, the wood is processed more efficiently and with less waste, and the consumer has more and better products available at less cost.

That is one example that illustrates the Laboratory's role in fulfilling its unique and formidable mission of conserving timber. Let me reach back in our history to establish the groundwork that led to such modern successes. I shall arbitrarily start by mentioning the man in Washington, McGarvey Cline, who, in 1907, had a vision. He proposed centralizing the widely dispersed wood research that was then sponsored by the U.S. Forest Service at a number of universities. His plan appealed to the first Chief of the Forest Service, Gifford Pinchot. That remarkable man felt that the forester's job was not to preserve trees, but to conserve them through wise use. And "use" did not end with the harvesting of a timber crop. Pinchot championed Cline's proposal because it had the potential of giving the Forest Service a leadership role in augmenting the utilization of timber to the benefit of the American public.

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Pinchot was joined by another outstanding conservationist, Charles Van Hise, President of the University of Wisconsin, who recognized the advantages of making this lofty task a joint venture with a great university. And so FPL came to Madison, with McGarvey Cline as its first Director.

Upon Cline's resignation in 1912, his immediate assistant, Howard Weiss, became Director. Following Weiss in 1917 for a period of 29 years, FPL was directed by Carlisle P. Winslow, known as Cap. He was a colorful, politically astute administrator who guided the Laboratory through two World Wars, a major depression, and a major building program.

Speaking of buildings, during its first 22 years, the Laboratory was housed in a fine building on the UW campus, constructed for it by the University. In 1932 the Laboratory moved to the large, strikingly modern main building that is still the nerve center of the outfit. Other major buildings were added in 1965 and 1967.

Already at its founding the FPL was expected to provide practical answers to technical problems of the pulp and paper industry, the wood preservers, the lumbermen, the makers of wagon wheels, and many others. The problems of finding the right balance between developing such practical technological information, versus fundamental research, were apparent in year one as they are still today.

Director Cline's initial statement of the Laboratory's purposes is summarized as follows: The Laboratory will seek:

1. Authoritative information on properties of commercial woods and their products.

2. Fundamental principles in preservation, fiber products, and wood use for chemical products.

3. Practical ways of using waste wood.

4. Dissemination of information on wood properties and utilization.

5. Cooperation with consumers on improvements in wood use.

An initial staff of about 50 people had been assembled by the time the Laboratory opened its doors on June 4, 1910. The leading scientists were mostly men who had conducted research sponsored by the Forest Service at a number of universities and in the Forest Service's "Branch of Products" in Washington.

Dr. Lee F. Hawley was the first of the pioneer section chiefs to arrive in Madison in July of 1909. He had conducted research on refining crude turpentine gum and established a chemical research group called the Section of Wood Preservation. Another closely related group, the Section of Wood Chemistry, was later combined with it under Dr. Hawley. He continued to head up and expand the chemical research program until his retirement in 1929.

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Harry D. Tiemann arrived in Madison in 1909 from Yale University to continue his research on wood moisture relations. He had already developed the so-called "humidity-regulated dry kiln", which was patented in 1911. Dry kilns were rapidly accepted in the lumber-manufacturing industry to speed the drying process and to reduce defects.

Young Dr. Eloise Gerry joined Tiemann's Wood Physics Section in 1910. She is best remembered for her contributions in naval stores research, in the course of which she trudged through the turpentine orchards of the southern states to study the effects of various "tapping" methods on the physiology of southern pines.

Wood-engineering studies were initiated in 1910 by Rolf Thelen and John A. Newlin. Their group promptly conducted tests to establish a full array of engineering data about American wood species, introduced the concept of classifying lumber into "stress grades" on the basis of strength, and with the help of L. J. Markwardt and others, published the Wood Handbook, the bible of American wood engineers.

Wood preservation research was led by F. M. Bond. In its early years, this research was conducted to determine the chemical, physical, and toxic qualities of various preservative chemicals and studies to improve the processes of preservation.

Already in 1910, Harry A. Surface moved a pulp and papermaking pilot plant from Washington to Madison. He was able to entertain the guests at the Lab's opening ceremonies by demonstrating the making of a continuous sheet of paper on his small Fourdrinier paper machine. Pulp and paper research was timely because of shortages of spruce pulpwood. Therefore, the Laboratory's demonstrations of using other species for pulp and paper were quickly accepted in the industry.

In addition to the six research sections referred to, another group belonging to the U.S. Bureau of Plant Industry was housed at the Laboratory. It was composed primarily of pathologists, and its function was to study wood decay, the physiology of wood-destroying fungi, and the toxicity and durability of wood. During the 1930's and 1940's, this group was headed by Dr. C. Audrey Richards.

Well, there you have it as it was conceived and got on its way. Very soon results flowed from the young scientists' pens: some as basic as F. Dunlap's "Specific Heat of Wood" published in 1912, and some very practical; for example, in 1916, 20 to 25 gallons of ethyl alcohol were made from a ton of waste sawdust.

As time went on, employees were added, but the total number did not exceed 75 before World War I. During that war, it skyrocketed to 450, only to drop again. During World War II it reached an all-time peak of about 700. At present it is less than half that number.

In addition to a policy of prompt publication of research results, some distinctive features of FPL policy helped to bring results into use. From the

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first, scientists cooperated with industrial users of wood to help them solve their problems. These included individual companies as well as associations such as the National Lumber Manufacturer's Association, the American Wood-Preservers' Association, and the American Pulp and Paper Association; public agencies such as the National Bureau of Standards, military agencies, and (later) Housing and Urban Development; testing and standards organizations such as American Society for Testing and Materials; professional and technical associations, and other scientists at experiment stations, universities, and state laboratories.

During the two World Wars, FPL's regular research program was interrupted to perform military research that had to do with wood in airplanes, ships and small craft, containers, buildings, antitank mines, and countless other products.

Within a few years of its founding, the Laboratory's reputation had spread around the world. Many industrialized and developing countries established national wood research laboratories modeled after the FPL. Scientists from the FPL accepted temporary assignments abroad to assist them, and young scientists from new foreign laboratories spent lengthy training periods at the FPL to prepare for research at their home stations.

On problems of wood research and development, the Agency for International Development, the Food and Agriculture Organization of the United Nations, and others have leaned heavily on the FPL for consultants. Also, the FPL has always been prominently represented in the International Union of Forestry Research Organizations.

Recently I came across a paper written by George Hunt when he was serving as fourth Director of the Laboratory. The date was 1948, just about the halfway point to our 75th Anniversary. It listed dozens of specific practical accomplishments. He concluded, and I quote, "Today virtually every use of wood known to man is directly affected by research done at the Forest Products Laboratory." Those who knew George Hunt will assure you that he was not known to make exaggerated claims.

In closing this review, I am reminded of a recent paper by the late Dr. George Marra, FPL Deputy Director from 1980 to 1983, in which he called the FPL's accumulated information and experience an "endowment"--something preserved so that its dividends will continue to benefit future generations. Because of this, FPL scientists do not need, as we say, "to reinvent the wheel." Future programs will build on past accomplishments. From a 75-year running start, FPL scientists must now make the quantum leap into what the National Academy of Sciences calls "the second industrial revolution." Let us now hear what our other speakers will tell us about that.

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Biological Potential
of Our Forests
and the Future
of Wood Use

Philip R. Larson, Pioneering Scientist

North Central Forest Experiment Station,
Rhinelander, WI

I bring greetings and best wishes from the staff of the Forestry Sciences Laboratory in Rhinelander to the staff of the Forest Products Laboratory (FPL) on this 75th Anniversary Celebration. This is indeed a memorable occasion for the Forest Service, for the staff of the FPL, and most certainly for all of us gathered here today. It is an honor to be asked to participate in this event.

My assigned topic, the Biological Potential of our Forests and the Future of Wood Use, is timely. We are on the threshold of a new technological era--an era that holds great promises for increasing the productivity of our forests. But like all promises, it is not without its challenges. And if we are to realize these visions of the future and to profit from them, we must be prepared not only to accept the challenges, but also to find ways to surmount them.

The forestry profession has met and overcome challenges in the past, some of which appeared formidable at the time. If we look back 75 years, to the time the FPL was established, forestry was also entering a new era that was equally challenging. The previous era of unrestricted logging and clearing of forest land was coming to an end.

The wave of forest exploitation that began in New England had recently swept through forests of the Lake States and the South and was spreading westward toward forested lands on the Pacific Coast. This era of forest exploitation was not without its benefits. It was accompanied by a realization that our virgin forests, although renewable, were nonetheless finite. And so a new era began in which large blocks of forest land were consolidated into public reserves.

Management of these reserves was at first primarily for protection from forest fires and timber theft. As administration of the reserves became more secure and the forests began to gradually recover from their past abuse, forest managers became more concerned with ways of improving the growing stock and increasing productivity of the forest resource.

In the years that followed, forest management practices increased dramatically. This has been particularly true during the past several decades. We now have the knowledge to achieve high levels of productivity on our best and most accessible forest lands by implementing a wide range of silvicultural and management practices. Despite these tremendous advances, we must still

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consider them conventional by traditional standards. Most increases in forest productivity have occurred by a gradual evolutionary process of improving the forest environment.

This is an ongoing process, and significant gains in forest productivity still lie ahead. I think we can safely predict that forest managers of the future will rely more heavily on scientifically designed silvicultural practices, that forest geneticists will make further progress in improving biological yield, and that wood technologists will continue their successful efforts at reducing forest waste and increasing utilization.

In addition to improvements in forest productivity by the traditional evolutionary process, tomorrow's forests will also benefit from results of the technological era we are now entering. Unlike advancements of the past, new research technologies will concentrate more heavily on the tree rather than on the forest. If we are to realize the biological potential of our forests, we must begin by exploiting the biological potential of the trees that comprise the forest. Putting the trees back into the forest will come much later.

At this time, I could speculate as to the great opportunities that lie ahead. I could relate to you some of the many ways that the new technologies might conceivably enhance the biological productivity of forest trees. As a basic research scientist, I am a confirmed idealist, and I become quite excited at the prospects the future holds. However, after 35 years of research, I am also a pragmatist, and so I foresee problems as well as challenges. Many of these problems are peculiar to research on trees. They have impeded research progress in the past, and they will continue to do so unless we fully acknowledge and properly address them.

I will return to these problems and impediments to research in a moment. But at this time, I would like to briefly digress to tell you about a research discovery that led to increased yields of corn. This little story on corn has direct pertinence to my theme of biological productivity in trees.

During its early growth, a corn plant produces new leaves one after another. These leaves are extremely efficient photosynthetic organs. However, at about ear-filling time, when the kernels begin to fill out, the plant stops producing new leaves. Also, at this same time, the older leaves on the plant decrease in photosynthetic efficiency, and they begin to senesce and then die. This is an extremely critical period in the ear-filling stage. To complete the ear-filling process, the plant draws essential food reserves from the roots and stalk. This withdrawal process seriously restricts the ability of the roots to absorb soil moisture, and it weakens the stalk's resistance to insects and disease.

Corn biologists solved this problem by breeding a corn plant that continued to produce new leaves during the ear-filling stage. These extra leaves not only produced the food materials necessary for ear filling, but they also contributed to a significant gain in corn yield. The simple beauty of this story is that the corn biologists didn't change the basic model of the corn plant, they merely redesigned it to make it more efficient at what it was already doing.

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How does this story on corn relate to the biological potential of trees? Several important points come to mind. First, trees are crop plants. As foresters, we don't often think of trees as crop plants. We are more accustomed to think of trees as components of a forest stand than as components of an economic product. However, when we begin to think of trees as crop plants, some of the problems peculiar to trees begin to disappear. We have much to learn from crop biologists, and I wish I had time to elaborate more fully on this relationship.

Second, the story emphasizes the role of green leaves in producing the photosynthates that contribute to crop yield. Photosynthesis is just as important to the yield of wood in trees as it is to the yield of corn. And so to increase wood yield we must find ways to increase photosynthetic efficiency of the tree crown. And, just as importantly, we must find ways to direct more of that photosynthate into the tree stem to produce more wood. This means that rather than simply mimicking nature and growing wild-type trees that serve the needs of nature, we must redesign the tree as a crop plant to better serve the needs of humanity.

And this leads to the final point of the story--the role of basic biological research. The breeder would have been at a loss in redesigning the corn plant if the crop physiologist had not possessed an intimate knowledge of its inner workings and the relationships of all its parts. In a similar way, we must acquire an intimate knowledge of the inner workings of the tree if we are to realize its full biological potential. If we are to acquire this intimate knowledge of how trees grow, we must change dramatically the way we think about trees--perhaps even the way that we conduct research on trees.

I will now return to my earlier theme--certain problems, unique to trees and forests, that are likely to impede biological research on improving forest productivity. Acknowledging that trees do present unique problems to forest biologists helps us to understand why research on forest productivity has lagged behind that of other major crop plants.

The first point that always comes to mind is research money and manpower. In the public eye, our forests hold vast reserves of native timber. Consequently, forestry never has and never will compete with agriculture for research dollars. As a pragmatist, I will simply dismiss this as an uncontrollable factor.

A second obvious factor that impedes biological research on the productivity of trees is their size and age. The large sizes and great ages of trees in the virgin forest made them ideal for a multitude of forest products. Today's forests consist of younger and smaller trees, a result of changing management objectives as well as economic constraints. But, even today's trees pose problems for the forest biologist.

In the past, basic biological research has not contributed significantly to the growth of large trees, although it has contributed greatly to our understanding of them. Most basic research is conducted on small trees grown either in controlled environment rooms or greenhouses. In the years ahead, these research facilities will become increasingly important as new technologies are introduced. But it is difficult to translate research findings from

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small trees growing under controlled conditions to large trees growing in the forest. To overcome these difficulties, we must introduce some form of intermediate testing stage in the growing cycle.

One intermediate approach is called agronomic forestry where trees are grown under highly intensive silvicultural conditions that attempt to maximize growth over short rotations. This approach permits forest biologists to test laboratory research findings under ideal field conditions before transferring them to forest stands. For some products of the future, the agronomic forest planting may be the final stage. For others, it might be a pilot-plant test--an intermediate testing stage between laboratory and forest.

A third factor impeding biological research on productivity of trees is the wide diversity of species in our native forests. We have dozens of tree species with commercial or potentially commercial value, and vocal constituencies can be found to justify research on each of them. As a consequence, our limited research resources are spread ever more thinly among many species of tree.

It is evident that the greatest advances in productivity have been made in those species such as Douglas-fir and the southern pines where research has been able to concentrate its efforts. Research has advanced not only because of the concentrated efforts of scientists, but also because of the synergistic effects of peer stimulation. I think we would all agree that scientists are more inclined to be stimulated with a sense of urgency and dedication when they are working toward a common goal on a commercially valuable species.

The final factor impeding biological research on forest productivity is what I refer to as product identification. The inability to identify with a specific product often presents a real dilemma to forest biologists. For most species, wood is the primary product. Wood, however, is a collective term covering a vast number of products ranging from poles and pulpwood to lumber and veneer. In addition, there is a host of reconstituted wood products.

Merchantability and quality standards vary greatly among the many commercially recognized species, and often a variety of products can be harvested from a single species or a single stand of trees. Most of these species are large and long lived, and they often grow in unmanaged or partly-managed stands on a wide range of ecological sites. Because of the wide diversity of species in our forests and the multiplicity of products harvested from them, we now know more about the products harvested from the trees than we know about the trees themselves.

There are no easy answers to the problem of product identification. However, forest biologists can partially circumvent the problem by placing greater emphasis on some basic principles of yield physiology. One of the simplest measures of crop yield is the harvest index, which is defined as the ratio of merchantable product to total biomass. In other words, how much of the total tree is converted into the final product. The harvest index of forest trees has been notoriously low in the past, although it has increased substantially in recent years with improved methods of harvesting and utilization.

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The challenge now facing the forest biologist is to further increase the harvest index by capitalizing on the untapped biological potential of our forest trees. This challenge brings us back to the new technological era I referred to earlier and also to the second part of my topic--the future of wood use.

I visualize three broad levels of management in forests of the future. The first level we might call extensive forestry. Extensive forestry would be confined to the more isolated and less accessible forest lands where silvicultural practices would be minimal. The stands would be regenerated naturally, and the rotations would be long.

The second level might be considered intensive forestry. This level would include the bulk of our better forest lands where forest management would range from moderate to state of the art. In these forests, considered nationwide, we would continue to grow a diversity of species and to produce a multiplicity of products. I do not foresee either dramatic or convulsive changes in management practices on these production forests in the immediate future. I do, however, foresee continuous progress in the evolution of new silvicultural practices and management strategies that I spoke of earlier. As these scientifically designed and tested management practices are introduced into the system, both wood production and utilization will increase accordingly.

I will refer to the third level of management as technological forestry. The technological forests would be similar in many respects to the fiber farms and energy plantations in the experimental stages today. The technological forests would be small in size, would be based on agronomic principles, and would employ highly intensive silvicultural practices. But they would be further refined by strong inputs from basic biological science. It is in these technological forests that the most promising results of the newly emerging sciences of biotechnology and genetic engineering would be first tested and perhaps applied. And, it is from these forests that we would begin to realize the biological potential of the tree as a wood-producing system.

If we are to realize the biological potential of our trees by capitalizing on basic biological research, then we must critically reexamine our research objectives. We must recognize and acknowledge that trees are crop plants, and like other crop plants, we can manipulate their growth to better serve our needs. We can redesign trees to increase their photosynthetic efficiency, and we can increase the efficiency with which they convert those photosynthates into wood. At this time, we cannot predict what specific characteristics these trees might possess, but it is only by redesigning them that we can capitalize on their tremendous genetic potential as wood-producing systems. Like the corn plant, we must redesign our trees to make them more efficient at what they already do.

In developing trees for the technological forest, whether by biotechnology or some other emerging science, we will be confronted with the same problems and the same dilemmas that have confronted forest biologists in the past. Therefore, our research strategy should concentrate on a very few, carefully selected species. We cannot afford the luxury of conducting basic research on every species of commercial value. We must also accept the fact that there

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will be no multiple-use trees in our technological forest. The trees will have high wood yields, they will meet high wood quality standards, and they will be uniform in size and product value. This desirable combination of size and uniformity will result in trees better suited for conversion into fiber and reconstituted wood products than into solid wood products.

I have very briefly and rather sketchily speculated on what our future technological forests might be like and the directions our research might take to develop them. At present, we do not have the basic biological knowledge to attain these objectives, but we do have the knowledge necessary to chart the way.

I mentioned earlier that we have much to learn from crop biologists. Today the harvest index of many agricultural crops is a source of envy to foresters. However, if we carefully evaluate the potential biological productivity of our forest trees, together with the almost total utilization of the final harvest, perhaps forestry can someday be a source of envy to the agronomists. I believe that we can meet these levels of productivity and utilization long before the FPL celebrates its next anniversary.

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Public Concerns Affecting Research in Wood Use

R. Max Peterson, Chief

USDA Forest Service, Washington, DC

In talking to this group, who represent years of experience as well as scientific capability, it might seem somewhat presumptuous of me to try to discuss some of the public's concerns with research. However, I'll briefly outline some of those concerns from my vantage point of managing a public agency that deals with research, state and private forestry, and the National Forest System. In that context, I see four major areas of concern.

Concern About Utilizing Private Forest Lands

First, the public is not a homogeneous body, but is representative of a wide spectrum of interests and problems. For instance, we have a fairly large group of the public who own forest lands. About three-fourths of the forest land in the United States is in the hands of individuals and corporations. Only a quarter of the forests are publicly owned.

Many of these owners want to know what they can grow that will be suited both to their land and to future economic opportunities. This means that they depend on Forest Products Laboratory (FPL) research, and on the new products that can be made from wood, whether they are chemicals, paper, or other finished products.

Concern About Wood Availability and Cost

A second major area of public concern is the future availability and cost of wood products. A major segment of the public is worried about the cost of housing and whether housing will be affordable in the future. I have some very personal experience with this situation and the anxiety it can cause. In the last year, three of my four children have been involved in buying housing. So I am particularly interested in FPL's research to reduce the cost of housing, both through more efficient use of wood and through new products that are lower priced.

We've already made great strides in wood utilization, thanks in large measure to FPL research. Utilization has gone from about 35 percent of the log in 1900 to an average of 60 percent today. Yet the public is disturbed about the amounts of wood that are still treated as waste, whether it's slash from logging or material put in solid waste disposal dumps. There is considerable public interest in making this waste usable. And, appropriately, substantial research at the FPL is devoted to improving utilization of material now wasted.

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In addition, the public is concerned about wood in use. How long will it last? Will it be infested with termites? How much fire protection does it offer? FPL research devoted to extending the usefulness of wood and making it safer is very important to the public.

The public is concerned also about the long-term cost and availability of derivatives from increasingly scarce petroleum-based products. To help fill such a possible void, wood has the potential of being a source of a number of important chemicals as well as an even more important energy source.

Concern About International Competition

A third area of public concern that I see focuses on the international community. People are worried, and rightly so, that in the world economy, U.S. production is being subjected to a higher degree of competition. So, to the extent that the FPL programs help the United States become more productive, whether by reducing costs or developing new products, those programs have a substantial bearing on the total U.S. economy and international well-being. For a long time, the United States operated somewhat as an independent economy from the rest of the world, particularly in the area of wood products. This is no longer the case and probably will never be again.

Concern About Land Allocation

A fourth major public concern covers many land management issues, particularly on public lands. For want of a better term, I'll simply call it the great land allocation concern.

In my experience, nothing is more consuming than the question of land use. Many interest groups and individuals devote great amounts of time and energy battling over the appropriate use of one piece of land or a group of lands in general.

Yet science is a substitute for land. Through faster growth or better utilization, we can produce the products we need from fewer acres of land. Agriculture professionals realized this long ago and capitalized on it.

John Erickson, Bob Youngs, and previous Laboratory directors have recognized the connection between better wood utilization and proper management of land-based resources. That recognition reflects the conservation policy in this country. This is not true in other countries of the world. Often, utilization is put in the building trades industries or in engineering departments. Here, we link utilization with land management programs because they are so dependent on each other.

Answers to questions now being pursued at the Laboratory could greatly lessen land use conflicts. So could the adoption of FPL technologies already developed. For instance, if the trussed-frame system were used in all new housing for a year, the amount of wood saved would equal the timber standing in all the areas set aside for wilderness or wilderness study under RARE II.

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In summary, I believe that public concerns affecting research in wood use focus on the four broad areas I've just described:

1. The appropriate utilization of private forestlands.

2. Future wood availability and cost.

3. The U.S. position in the international market.

4. And, better utilization of raw material and development of new products that can ease public land allocation issues.

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Wood Science and Technology in Historical Perspective

Robert J. Seidl, President (retired)

Simpson Paper Company, San Francisco, CA

Thinking of how to address you after so many years of absence from the scene generated a wave of nostalgia, and the sights and smells of the Laboratory in the setting of June in Madison is a heady mixture. I am honored that you should invite me to reflect on what has transpired at the Forest Products Laboratory (FPL) since long before and long after my own happy years here. Apart from the fun it gave me then, I have often felt grateful for the training, background, and experience that have helped me to cope with other assignments that have come my way. During those days in Madison, I developed some strong convictions and an eternal enthusiasm about wood.

Understandably today's assignment brought to mind my original contact with the Laboratory, which employed me briefly for college credit but with no pay. My first project had the impressive title "Recovery from Compressive Deformation of Wet Pulp Mats." I still treasure a copy of my report. As I recall, it was not a bestseller, but it was one of my first exposures to the scientific method, and it gave me the encouragement of finding one small bit of information that others before me had not discovered. I had the challenge of assembling the equipment, making the tests, and being satisfied that others could duplicate and confirm my results.

The satisfaction from specific projects persisted over the years and through many experiments. This taught me a solid respect for the scientific method. Indeed, as events took me further away from this discipline and into administration or management, I was never certain that my satisfaction level was improving.

To bring history into time perspective, a chemistry professor I had at this university used to dramatize an event, such as Joseph Priestly's discovery of oxygen, by noting that when the event occurred "the streets of London were lit by gaslights," and that "George Washington, although he was an engineer, knew nothing about oxygen," and so on until the time setting was easy to visualize.

One point of reference for my exposure to the FPL is that I could ride out from the campus for five cents and would often walk back to save a nickel. Another more touching reference is that at that time a fairly young couple named Alfred Lunt and Lynn Fontanne were dedicating this elegant little theatre where we are meeting today by playing "The Taming of the Shrew," about 45 years ago, in October of 1939.

Such trivia is only to document that I have been associated with the Laboratory in flesh or spirit since about 1938, and it has made a lasting impression.

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I remember its directors, starting with Cap Winslow through George Hunt, Al Hall, Ed Locke, Herb Fleischer, and Bob Youngs, and just yesterday I met John Erickson.

My first laboratory experience and some earlier work in a Wisconsin paper mill built up my interest in wood, but I was unable to find work in the field, so I took a job as Chemical Engineer at the Seagram-Calvert distillery in Louisville, KY. Strangely, that job was offered to me because my work at the FPL implied that I knew enough about wood to work with the "King's ransom" in new white oak used in whiskey barrels. Of course, I never admitted how obscure was the connection with my wet-pulp mat study.

There is a beautiful historical story to be told about how wood met the earliest needs of man for fuel, structures, and implements; the part it played in the industrial revolution; and its position in modern commerce and culture. While this story supports our future aspirations, we should not dwell on it here. Rather in these few minutes, let me try to give perspective to both past and future as it involves growth and management of the resource as well as its uses, noting especially how growth and utilization are intertwined. Here we should view all the products made from wood, be they lumber, plywood, particleboards, pulp, paper, chemicals, or energy.

I do have a central conviction about the national wood resource, and it may come into better focus after some comments on what the FPL has accomplished over its 75-year span. Its technical achievements are well documented in publications. A list of specific accomplishments, and recognition of its scientists, is too long a litany for today. I will just mention some highlights to show that we are not dealing only in generalities. I have selected 29 items from my memory that seem to encompass the scope if not the particulars.

1. The first big mission was the orderly testing and identification of most of the world's woods, and publication of findings in handbooks so that wood could be put to its best use. Nothing similar had been done before, and the "Wood Handbook," first published in 1935, has long provided a basic reference.

2. Refinement of test methods for wood in solid, fiber, or chemical form, which serve as a very important international language in the use of wood.

3. Studies of wood properties in relation to growth conditions as a guide to forest management, tree improvement, and genetic programs.

4. Fundamental studies of moisture movement in wood led to very useful charts showing the equilibrium moisture content reached by wood at various relative humidities. Forest products operations cannot ignore the fact that wood is always responding to its moisture environment. Observations on the need to remove water from wood gently to prevent checks, cracks, and warping led to the development of the internal fan dry kiln, a key early accomplishment.

5. Pioneering work in the preservation of wood against decay and fire, which was immensely important to its usefulness. Think of what this has meant in the building of railroads, bridges, and in general construction. The Laboratory is a center for mycology research, which deals with the collection, identification, and description of wood-rotting fungi.

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6. A newer area is that of biotechnology, which involves the manipulation of microbes and enzymes to produce useful bioreactions. This promises to open entirely new vistas.

7. Fundamental work on paints and surface coatings for wood to extend its life and enhance its beauty. Beyond surface treatments, the Laboratory found methods to penetrate wood with resins, yielding durable products known as "Impreg" and "Compreg." Such products were used in floors, airplane propellers, aircraft carrier decking, and are often seen today in kitchen knife handles.

8. Understanding the complex chemistry of wood has been an ongoing effort, serving at various times in history the need for naval stores, chemical intermediates, extractives, explosives, rayon, flavorings, alcohols, fuel, and many other items. Beyond the yield of useful products, knowledge of wood in its molecular form is very helpful for other uses, such as for converting wood to pulp.

9. Studies of the mechanism of bonding wood with adhesives and test methods for the products. These defended the integrity of the bond and made great contributions to exterior plywood, laminated beams, and more recently to strandboards.

10. Detailed studies of structural use of lumber, plywood, and laminated beams, which extended their use and guided code decisions. I believe the first large laminated beam in the United States was produced here.

11. Design criteria were developed for beams and columns, including allowable stresses, use of fasteners, span tables for various species and for constructions that best resist earthquakes. In recent years this has naturally involved computer-aided models of structural behavior.

12. Methods were refined for testing the strength of lumber without breaking the piece under test, which is important for wood since it is variable in nature. This permits wood to be used in a true engineering manner.

13. Development of the first stress-skin glued prefabricated house, helping to pioneer the factory-built house. A much later development (1978 prototype) was the truss-framed system, which is a unitized element of roof, floor, and studs that saves time and lumber.

14. Methods of processing logs to get maximum volume of wood products were examined. You can imagine the complexity of obtaining the maximum yield of rectangular boards from logs that are round, tapered, and irregular. Other examples included the use of a power back-up roll in peeling logs for veneer, or in thick slicing of logs and gluing the slices into a lumber product. This eliminates sawdust and gives more uniform strength.

15. Early theory and recommendations on the use of vapor barriers in the walls of houses and how their abuse can cause decay and paint failures.

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16. Theoretical mathematics and practical applications for stressed-skin sandwich panels. These studies were sponsored by the military, but they opened vistas for very efficient use of the resource.

17. Basic work on wood and fiber products in packaging, including necessary test methods. A very large percentage of all wood used in the form of lumber, plywood, and paper is dedicated to packaging.

18. Development of high-strength paper plastics, perhaps five times as strong as anything developed before, again done for the military, and used in glider floors, aircraft parts, and other products.

19. Overlays for plywood, both medium and high-density types, that emerged as a spinoff from the military structural plastics effort. This provided an interesting synergism on which I wish there were time to elaborate. I had the fun of helping this one into commercial use.

20. Semichemical pulping of hardwoods was a major development at Madison and led to an immense outlet for so-called "weed species," resulting in millions of tons of pulp production. The Laboratory helped to start the second commercial plant.

21. Hardwoods in corrugating board were stimulated by the mathematics of stressed-skin panels, showing that stiffness rather than toughness of the corrugating medium was central to a good box. A small concept, perhaps, but one with a vast commercial impact.

22. There was a general program on use of residues and otherwise unused species for pulp, including an ongoing search for higher yields and methods for bleaching such products. Many laboratories study wood, of course, but I know of no other that had such a determined and sustained focus on finding practical use for what many considered to be waste.

23. Pioneering work on pulping and especially bleaching of southern pine for packaging, printing papers, and newsprint, which helped to boost this gigantic industry.

24. Pulping of Douglas-fir, so important to the West, was intensively studied. I believe the Laboratory published about 20 technical reports on pulping this species before that industry began.

25. Press drying permitted short-fibered hardwood paperboards to have a superior bonding and performance with less process energy needed. This study stems from fundamental understanding both of fiber bonding and engineering properties of the product. It is a creative idea, relatively new, and its commercial use is still ahead.

26. Pilot-plant studies, which are necessary to scale-up laboratory discoveries and also to demonstrate to the business community what might be achieved, are a continuing Laboratory activity. Such trials expose problems in larger scale operations and build conviction for commercial action. These have been a catalyst to a number of large commercial plants that I could identify.

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27. Recycling of fiber has been the subject of other more recent studies. There is elemental logic in the assumption that reuse of paper reduces the need for new fibers. This enables us to tap the big city wastes, or the "asphalt forest," as someone has described this resource. It is also worth noting for the future that 1 ton of wastepaper upon combustion yields heat equivalent to about two barrels of oil.

28. As a central reference point for woods of the world, a reservoir known as the "Madison Collection" was assembled, with special help from Yale University and the Field Museum, that now houses over 100,000 specimens. This is probably the largest in the world. Identification and retrieval is assisted by computer.

29. Some Laboratory studies are not for economic benefits. Such tasks as aiding law enforcement by analyzing wood found at crime sites, identifying the wood species and age of ribs from a long sunken ship, or helping to identify the wood in a family heirloom are undertaken as a public service.

Apart from specific items, one might condense the Laboratory activities into the identification and understanding of wood in a macro and molecular sense; the relating of its properties to forestry conditions, the protection of wood, the bonding of wood in solid or subdivided form, and development of processes that increase its yield or usefulness in fiber or chemical form. The program of the Laboratory is often said to be justified as support of our big national forests, but in fact, the results of FPL research reach everyone that uses wood. Nature does not recognize ownership borders.

An institution is also measured by the quality of its people. Since literally hundreds have been involved in the Laboratory's history, it seems best to mention none by name, even though so many are before me in this audience. Many received special awards, and their publications are found everywhere wood science is of interest. Five scientists who worked at Madison have over the years received the Gold Medal of the Technical Association of the Pulp and Paper Industry, the highest annual award of a group of many thousands involved in technology of pulp and paper. I was pleased to make the presentation speech in New York for one of them, in 1960, 25 years ago.

Most of the accomplishments of the Laboratory have contributed to better utilization and extension of our wood supplies. This has been given impetus by estimates of population growth, increased product needs, depletion of forests, and periodic predictions of "timber famine." I have watched for a considerable number of years from a front-row seat, and I have been absolutely fascinated by an apparent paradox between the demand and the supply. As wood use increased, the supply seemed to increase well beyond what growth could yield.

As a single example, not much over 100 years ago very little wood was used for paper. Today nearly half of all wood production feeds this big industry, yet the demand is well met mostly by utilization standards never dreamed of earlier. As another example, the demise of big trees seemed to spell the end of big beams, but through technology we can produce laminated beams far bigger and much better than any we could make before. The large peeler logs for plywood are certainly becoming scarce, but the technology of particle, flake, and strandboards, along with overlays, promise to fill any void.

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The observation that shapes my perspective is that the effective volume of wood can be multiplied by deeper utilization of what grows, and that defines a main objective of the FPL.

The overall result of the steady focus of technology on utilization of lower grade wood substances has been to make wood abundant beyond prediction. I almost dislike making the following point because it may be offensive to some of my forestry associates, but my position is that, broadly viewed, wood on our continent has never really been in short supply, and that the real challenge has been to find markets for all the wood available. Indeed, today wood is so abundant as to discourage investment in better forest management.

It is true that there have been wrenching changes in several locations. The migration of sawmills toward virgin timber, from East to Midwest to South to West, brought big opportunity and also big problems. The shift from old-growth to young-growth timber in the West is causing a very difficult restructuring of a big industry. On the other hand, there was the massive evolution from lumber to pulp and plywood in the South and Southeast, and a new resurgence of pulp and paper in Midwest areas that only recently seemed so short of useful trees. We have huge numbers of small trees, and technology has shown us how to make things from them that replace or improve what came before. Our cries of scarcity were based on visions of tree size we may never again need in large volume. The commercial value of our resource should, after all, be measured in dollars, jobs, growth, economic stability, and not only in board foot units of logs and lumber.

All of this in no way diminishes my zest for good forest management using all of the tools and disciplines that can increase growth. There is no substitute for large volumes of wood as industrial raw material.

Although this day is really a celebration of work spanning three-quarters of a century, I cannot resist leaving a few summary thoughts about how gains in utilization of trees fit into the total forestry issue.

1. Deeper utilization of the current forests through technology vastly increases the effective volume of wood, and does so faster than changes that are caused by silvicultural methods in the forest. Indeed, the evolution through technology of gluing, particles, pulp, and chemicals has caused wood, broadly viewed, to be abundant rather than scarce. This represents great progress and relates to the mainstream of research at the FPL.

2. Earlier concepts of wood quality expressed in the classic terminology of the lumber industry are inadequate for the future. The economy cannot wait for nor afford to grow much of what once was freely available, but it must have large volumes of wood of moderate quality in proper locations.

3. Those who grow the raw materials and those who use them have been too far apart. There is a great synergism possible when the benefits of good utilization are in turn fed back to support better forest management.

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4. The shocks that come with the demise of old-growth forests are mostly a one-time affair. The young-growth forests invite an easier equilibrium, and they induce stable investments. A hallmark is more integrated utilization that works toward using each increment of raw material for its highest value.

5. Utilization of the forest has evolved from lumber to plywood to particleboards and flakeboards; to pulp, paper, and chemicals. What cannot be used for these, plus much substance from the forest floor, can be used to generate energy. It is a wonderful gift of nature that clean-burning wood waste converts so easily to electricity and steam in proportions that fit the processing of the pulp and paper industry. One can make an interesting story of a wood-processing operation that derives both product and energy from the sun and is an effective solar engine running without depletion. The pace at which more wood is used for fuel will be influenced largely by the price of oil. At any rate, wood as fuel emerges as the final link in its utilization.

I have tried to point out the considerable accomplishments of the FPL and to indicate how the results of technology dramatically increase the effective resource.

This Laboratory can be an engine of change, and I would hazard a few thoughts on how it should proceed. Although its contributions are impressive, this is no time to rest on our laurels. Rather, let this anniversary be an occasion to inspire excellence and the wisdom to adapt to contemporary circumstances. It might be time to reexamine priorities, to drop some efforts, and to add others. Indeed, willingness to displace some existing projects is one measure of your conviction about a new one. Most would advise you to focus on the fundamental, but a laboratory this large needs some practical and pilot-plant work for perspective. I know you will continue to work closely with your clients, the public. There should be no petty concerns about academic versus industrial research, or fundamental versus applied, but rather we should aim at the necessary and the useful. While it is fun to publish, we should contribute to the lines of commerce as well as to the filling of library shelves.

This Laboratory can be a good middle ground between the universities and industry, and it is the source of thousands of publications and books. The FPL has long been a focal point for communication on the entire spectrum of forest products research. It is a meeting place where scientists from universities and industry can exchange ideas with the Laboratory staff, and thus help to diffuse information among the research fraternity and those who might put it to practical use. I believe the FPL would multiply benefits on a national scale if it could isolate and articulate major problems in truly scientific terms and thus capture the interest of many more university scientists. Sadly, research on wood does not seem to rate much dignity in many universities.

One hazard of a large laboratory structure is a tendency to refine known facts beyond current needs and thus to reduce discovery at the cutting edge. Since this Laboratory does not operate for profit, it is ideal for trying bold and innovative approaches. "Inching along" with technology may be comfortable, but as stated in an old axiom, "no amount of incremental gain would have taken us from the horse to the internal combustion engine."

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Let me close with a philosophical point about wood from the forest. The mission of the Laboratory is technology aimed at using the resource wisely to serve millions of people. Success is usually measured in terms of large volumes of useful products, made with utmost efficiency at the lowest common denominator of price and cost. Products often compete with those of metal, plastic, concrete, oil, or other materials which, unlike wood, are not renewable in nature. Beyond this competition is the wonderful aesthetic value of wood.

As we work with millions of tons of wood as a crass industrial material, we should also reflect on the inherent beauty and friendliness, if you will, of this material. It is versatile, easy to shape, warm to the touch, has pleasing nonrepetitive patterns, and is deep in our culture. As it derives from its source of sun and soil, it carpets much of the earth, gives us recreation, habitat for wildlife, oxygen regeneration, and control of water supplies. We borrow its substance for structures, furniture, packaging, publications, and a host of other uses. It is emerging for the second time in history as an important source of heat, and its sulfur-free combustion warms our homes or powers wood-processing plants without the fears associated with some other fuels. It does not need to be harvested quickly as food crops do but grows patiently for years until needed, serves its purposes, and returns to nature for renewal. Perhaps this is the gentle advice "to stop and smell the flowers" applied to the largest garden of all, our forests.

Thank you for inviting me here. I have high hopes for the new dimensions that your future work will bring to the people and forests of the world.

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A Researcher's Perspective of Science-Driven Opportunities to Improve Wood Utilization

Norman E. Johnson, Vice President,
Research and Development

Weyerhaeuser Company, Tacoma, WA

Forecasting is particularly tough, especially when one is talking about the future--so goes the story. There have been so many bad forecasts about what technology will bring that one always hesitates to predict anything. However, scientists are expected to think ahead and produce the products of the future. For sure, it is fun to do.

Now Versus Then

I've recently torn down a house, board by board, that was built over the past 50 years. In the process I was reminded of how wood usage in a house has changed over the years. Here are some of the things I noted:

- Lath and plaster gave way to sheetrock.
- Three-quarter-inch, clear or knotty pine paneling gave way to 1/8-inch-thick lauan covered with plastic.
- Board underlayment for both floors and walls gave way to half-inch plywood.
- Vertical grain Douglas-fir flooring gave way to carpets over particleboard.
- Earlier door and window casings had three to four times as much solid wood content as later ones.
- Wood-framed windows gave way to aluminum.
- Shingle and shakes on 1-inch-thick boards gave way to paper over plywood.
- Early moldings and trim had many times more wood volume than later trim. Current style is for no trim at all.
- Wood fiber insulation gave way to fiberglass.
- Dimension lumber is 25 percent less in volume.
- Beams of solid wood gave way to false beams containing a fraction of the wood content.
- Three-quarter-inch-thick siding gave way to 3/8-inch designer plywood.

To top it off, when my wife brought me lunch, it was in a plastic bag!

And there are the other obvious trends of plastic, aluminum, and steel siding; concrete or metal roof tiles; metal studs and framing; and so forth. Will these trends continue? The answer is assuredly yes as long as there are substitute raw materials that are either less expensive, perform better, or have special appeal. What can we do in the forest industry to preserve and expand our markets? The subject I was asked to address relates to science-driven opportunities to improve wood utilization. Perhaps I'll violate my charter when I say that one of our problems is that science-driven

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opportunities may be the wrong focus. True there are a number of examples of products looking for a market. There are three times as many examples of products developed because of market needs.

To begin with, I feel wood products companies have lost opportunities because of too narrow definitions of their businesses and too strong attachment to wood. Heresy you say? I say just good business. Let me explain. If a company or a business in a company defines its business as lumber or plywood or even broader as forest products, look at how this affects the decisions it makes. It has been said that if the buggy whip makers had defined their business as vehicle accelerators, they would still be in business. It wasn't until railroads defined their business as transportation that they began to come out of the doldrums they were in.

One of my objectives is to get our company to define its businesses without naming a product such as lumber, plywood, brownboard, fine paper, etc. Instead I see lumber, plywood, and composites as being part of a shelter business. I see fine paper and newsprint as being part of a communications business; brownboard as part of the "safe transport" business, and so forth. Now if a company defines its traditional wood products business as a shelter or structures business, it will better be able to grow with customer needs. Let me give some current examples of what too narrow a definition of our business can do. The first example relates to panels and the formaldehyde issue. With the formaldehyde scare came a flurry of activity to reduce formaldehyde in plywood and particleboard. This was a noble and important effort, but while we were trying, the gypsum manufacturers moved in and took 75 percent of the interior mobile home skin market with quarter-inch gypsum. Had our objective been to cure the problem without constraints as to how, we may have operated it differently.

Another product I see gaining rapid acceptance in some parts of the country is concrete roof tile. This product makes a beautiful, long-lived roof that is replacing one or more forest products. If one is in the wood business instead of the structures business, he is likely to react with some kind of defensive program to protect wood rather than to look for ways of integrating this excellent product into his structures business.

Being in the structures business instead of the wood products business would force one to look at things like fire-safety equipment, energy systems, security systems, lighting, paints, wallpaper, floor coverings, landscaping, and you name it. The danger would be trying to do it all on one hand and beating a narrow path to extinction on the other.

Defining fine paper and newsprint business as part of the communication business will lead to expanded product opportunities. Brownboard could be looked at as part of the business that safely delivers and sells a product. In other words, looking at one's traditional businesses in this light will lead to new product ideas. If the scientist is an integral part of the business, he or she is likely to be more effective than if working alone in a laboratory. However, some very good products have been developed that way. 3M Corporation feels that 70 percent of their new products are developed to solve a market need, and the remaining 30 percent are products looking for a market.

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So in talking of science-driven opportunities to improve wood utilization, I will stress science support of market-driven opportunities to improve the structures business or the communications or transportation business. This presupposes that research is closely coupled with the marketing of the product. With the assumption that the scientist will work more closely with the end user, here are some of the areas of interest to my company.

Computer-Aided Design

The computer will have more influence in changing the nature of structures made of forest products than perhaps anything since the invention of the 2 by 4. The computer is being used to optimize structural, thermal, and acoustical properties. Computers will be used more to control energy usage, protect structures from fires, and increase security. With materials as uniform as steel or aluminum, one can use a computer to design a structure with little or no waste. If wood is to compete in this environment, it will be necessary to produce wood components with predictable and reproducible properties. As our trees get smaller and growth rates faster, the sawn products from them will often not be as high a quality as sawn products from older, larger trees. Therefore it seems logical that composites and manufactured parts will become much more numerous than in the past.

Components

A couple of years ago my son and I and a carpenter built a house in North Carolina. I was unfavorably impressed by the great variability in the wood I used. For example, I took small sections from 2 by 4's from one bundle and found that the weight varied by a factor of nearly 2. There were some 2 by 4's that had only four rings per cross section; others with a hundred. To point out the obvious, fast-growth juvenile wood was weak, but one searched for those pieces whenever ease of nailing was called for. Fast-growth non-juvenile wood was the strongest, and those very dense, slow-growing pieces made better firewood because of the pitch and because they always split when nailing. From this experience I concluded that a simple (operators say it isn't simple) sorting of material by density would be useful to the user. I would have paid a premium for straight pieces of juvenile wood for certain uses. The point is that we're just not turning out sawn materials uniform enough to be in a class with other building materials. Therefore one surmises that components and composites are the way to go.

In this same house I used both roof and floor trusses. Even though the wood in the trusses was no better than that from my bundle of 2 by 4's, the final product was more uniform and had more predictable properties. This was a start. One couldn't help thinking that the next thing would be wall components, and this is happening to a degree. I read a statistic recently that 40 percent of all single-family housing is manufactured now offsite in one form or another. Assuredly this trend will continue. Few large companies have been successful in this arena. The Japanese and Swedes are pushing hard in this direction, and unless we're careful, the "Honda" home will hit us with the same force that the Honda automobile has--smaller, high quality, high technology.

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In commercial buildings, the trend towards using components is much more rapid. With the large construction equipment available, one sees commercial buildings of all sizes being put together with steel and concrete components. Wood components are holding their own in some sectors. Again, however, we've got to give more attention to producing a product that is consistent in quality and competitive in price.

Composites

There is a contingent that is looking at tree pruning to produce wood that is structurally sound and aesthetically pleasing. The New Zealanders, Europeans, and Japanese are all growing wood for the quality market. I think we should be doing some of this also, but we're considerably behind the need. It will take 10-15 years to produce significant amounts of clear wood from pruned trees and a lot of capital to change our sawmills to benefit from this clear wood. In the meantime I think that composites and components will take over much more of the structural market.

Even though energy and glue costs are important factors, I have the feeling that reconfigured wood products will increase substantially in importance. Looking at the small logs from plantations, I see an opportunity for making the 2 by 4 by 8 the basic unit for solid structural timbers. One-hundred-inch logs, cross hauled to very fast small-log sawmills with automatic scanning, grading, defect sensing, defect cutting, and refitting may be one way to provide larger structural pieces--really a mini glulam concept, but done much faster. We'll have a large excess of No. 3 lumber coming from plantations. With this technique, a lot of this material can be utilized. The lower strength material can be put in the interior strands, the stronger material on the exterior or where needed. We need to do something with wood from fast-growing juvenile trees. The slow-growing timber from Canada and Russia will be an increasing source of clear sawn wood for the next few decades.

An obvious growth area is in fiber and particleboards of all types. Oriented strandboard is an excellent and well-received product. To date, the main product is a 4 by 8 sheet, but it won't be long before we'll see thicker boards, molded and folded sheets, and other configurations as needed to meet specific market needs. Lumber made from strandboard or similar processes is being test marketed now. These products will lend themselves much more to computerized construction than sawn wood.

Steam-through pressing will allow us to make fiber and particleboards of any thickness. These materials can be reshaped for special uses. I see this technology being more important as large trees become a thing of the past. Better continuous pressing to form larger sheets for components is going to be important. When one looks around at the revolution in construction equipment and transportation systems, one has to think that the 4 by 8 sheet is not the only alternative.

Then there is the area of combinations of wood with other materials such as concrete, metals, plastics, graphite, and so forth. All of these materials have been combined with wood in one fashion or another. Yet, I see that we've

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only scratched the surface on the possibilities. It is in this area that science-driven products can be developed. There is a market for a product to replace gypsum board and for better and more durable roofing and siding products. But they will not come from solid-sawn wood and probably not from products made entirely of forest products. Much more work is needed on the development of new classes of materials to be used in both the traditional wood and fiber industries. I'd like to talk a bit about the fiber side before closing since most of what I've had to say has been on the wood side.

Fiber Technology

Interesting enough, some of the juvenile wood properties that are detrimental to solid wood products are turning out to be positive for fiber products. The premier pulp in the world now, as I was told by a noted Swedish researcher, is made from 7-year-old Eucalyptus grown in Brazil. Wood from young loblolly produces linerboard that has improved properties. Wood from trees of the same age will give more uniform furnish, and this allows the scientists to do more with this material.

Another area needing substantial research is in developing new classes of materials from blends of natural and artificial fibers of all sorts. The number of nonwoven products continues to soar. I don't think that the forest products industry is making enough of an effort in nonwoven products, particularly the area of mixing natural fibers with artificial ones.

One trend obvious to all who get a Sunday newspaper is the amount of color-printed newsprint. Supercalendaring and coatings are making some newsprint nearly as printable as coated bleached paper. The boundary between newsprint and bleached kraft will continue to blur and merge. The trend towards sharply printed color images will continue. In the box industry, this is equally apparent. Toy boxes were the first to be designed to sell what was in the box. I bought a belt sander last week at Sears, and the box was more impressive than the merchandise! Even in those boxes that are not overlaid with a white, printable surface, the quality of printing is paramount. Here the trend is towards color of high quality also. Black inks were predominant 15 years ago. Today black ink is way down the list in usage. A close tie to marketing and an appreciation for advertising seem to be clear prerequisites for successful product development in the paper and packaging arena.

Please allow me one more personal experience. I've been cleaning up around our new house that is being constructed on the site of the one I tore down. I've hauled three pickup loads of plastic material to the dump compared to one load of corrugated boxes. This just added to my concern that unless we, in the forest products industry and in the forest products laboratories, take a broader look at what our business is, we're going to see more erosion of our products and our profits.

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Let me close with the observation that American industry is spending too much time looking inward and not showing enough concern about what foreign competition is doing to us. The Scandinavians are spending more than 10 times the amount for pulp and paper research per ton of pulp produced than are American companies. The ability of the Japanese companies to focus their research efforts continues to make them formidable competitors. Countries like New Zealand will double their timber output by the year 2000. Chile, Brazil, and South Africa are becoming more important competitors each year. I think that it is time that the American forest products industry reassesses its cooperative forest products research effort and begins working more closely together on generic research that will improve the overall competitive advantage of the forest products industry. Not long ago it was commonly thought that agriculture and forest products were industries that we did not have to worry about remaining competitive in. The story today is different. There are no sacred cows or blue oxes.

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Banquet Presentations

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The Formative Years:
The Men and Their Era:
Gifford Pinchot
and Other Leaders

R. Max Peterson, Chief

USDA Forest Service, Washington, DC

We don't know exactly when the seeds of forestry research were first planted in this country. Nor can we single out one individual who planted them. More importantly, however, we can appreciate a number of leaders who nurtured forestry research.

Certainly, one of those leaders was Gifford Pinchot. When he became Chief of the old Bureau of Forestry in 1898, he set out to create an atmosphere in which forestry and forestry research could grow and prosper. During his early years in forestry, Pinchot spent a great deal of time developing information of use to private landowners. His guiding philosophy was that trees are a renewable resource and that people who own trees need updated information on the best ways to manage them.

His first year at the Bureau, Pinchot established research as an arm of the agency. By 1902, it claimed one-third of the agency's budget. When the Forest Reserves were moved to U.S. Department of Agriculture, Pinchot was even more convinced that research was essential to these lands. High on his list of priorities was finding ways to utilize trees to avoid waste and to provide products from the Reserves and other public lands.

Pinchot had come into a fertile environment for research. Years before, President Lincoln had called the USDA the "people's department," and stated that its fundamental mission was research and education. Lincoln believed that farming was the result of education, and that farmers put education to work for improved farm production.

I don't want to give the impression that Pinchot was the only leader who championed the cause of forestry research. There were many individuals--and I'm proud to say that a number of them chose to work for the Forest Service and its predecessor during this formative era.

You might say that the first Federal money spent on forestry was spent for research. In 1876, $2,000 was appropriated for "investigations and inquiries" into the use and condition of the forest resource, and Dr. Franklin Hough was assigned to gather data on forestry. Bernhard Fernow, as the first Chief of the old Division of Forestry, recognized the need for a research program early on. He said, "Crude experience has been our guide and crude has remained our knowledge." In 1887, he wrote a systematic plan for forestry research.

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The universities--Cornell, Harvard, Iowa State, Michigan State, Minnesota, Wisconsin, and Yale--added to our research heritage. From the beginning, the Forest Service had a treasured relationship with the universities--and throughout our history, much of our research has been carried out in universities.

In 1908 and 1909, it became clear that we needed greater and more centralized facilities for research. It was McGarvey Cline who proposed establishing a centralized wood-testing laboratory in cooperation with a technical school or university. It was also Cline who convinced Gifford Pinchot that the idea had merit. As the first director of the Forest Products Laboratory (FPL), Cline had a lasting influence on the shape of forestry research in this country.

A number of universities were keenly interested in providing facilities and made generous offers. In fact, the competition became so keen that it reached President Theodore Roosevelt's office. The University of Wisconsin was chosen as the site of the FPL and construction started in 1909. At that time, the Lake States area was the country's greatest timber producer, but already the resource was running out.

The formal opening of the Lab--on June 4, 1910--came almost 5 months after President Taft had fired Pinchot. On that first day, the Lab had about 45 employees. Just to show that some things never change, I should mention that we originally underestimated the staff that would be needed--calling for 14 technical people and 6 assistants. But, to show you that some things do change, we proposed to pay those 20 people, in total, the magnificent sum of $28,000!

There were several other individuals who helped establish either the FPL or the research programs that followed. For instance, Raphael Zon was a prime mover in creating the Lab. He also played a leading role in establishing the forest experiment stations, as well as championing the cause of freeing research from administrative snarls.

In 1915, Henry Graves, one of my predecessors as Chief, established the Branch of Research and named Earle Clapp to direct it. Clapp, another early Chief, became the architect of Forest Service research. He built support for major research legislation, the McSweeney-McNary Act of 1928, and proposed a series of 10 regional forest and range experiment stations. His legacy is still with us today.

And, we cannot forget Sam Dana. He joined the Forest Service in 1907 and was later Assistant Chief of the Branch of Research. He went on to direct the Northeastern Forest Experiment Station before undertaking his legendary work as Dean of what was then the University of Michigan School of Forestry and Conservation.

These pioneering leaders of forestry research are gone. But the FPL is still providing us with pioneering research into new fields with new leaders to carry on the tradition of practical research in a changing world. In bringing together resources to form the FPL, these men have created an atmosphere that has nurtured generation after generation of new leaders and scientists. This is their greatest legacy to us and to future generations.

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The Formative Years:
The Men and Their Era:
Charles Van Hise

Robert M. O'Neil, President

University of Wisconsin, Madison, WI

It is a pleasure and an honor for me to play a modest part in this appropriately immodest celebration. For one who bikes almost daily past the Forest Products Laboratory (FPL) on his way to an office atop Van Hise Hall, the link between a revered predecessor and a facility he helped create is inescapable. Yet the connection may not be so obvious for many, and it is to describe it more fully that I welcome your invitation for the evening.

President Charles R. Van Hise served the University of Wisconsin well during his 15-year presidency (1903-1918). In fact, most of his adult life was devoted to the university at which he enrolled as a freshman in 1874 and where he studied, taught, and administered until his death, soon after the end of World War I. He has been honored in countless ways--most visibly by the campus' tallest building--but in less tangible (if no less durable) means by colleagues here and elsewhere.

If university presidents (even great ones) are human, then so too was Charles Van Hise. He did not win all his battles with Regents, legislators, or even colleagues, and he did misjudge a few policy questions. For example, he opposed granting formal hearings to faculty members who faced dismissal or termination and thus angered the fledgling AAUP in 1915. While he supported coeducation in many facets of university life, he also urged segregation by sex of certain university classes. But with these few rare lapses, the Van Hise years were an exemplary period in the University's growth and maturation. A Regent resolution passed by the Board immediately after his death acknowledged: "To know him was to love him, to serve with him a privilege, and to serve under him a benediction."

Much could be said of Charles Van Hise's contribution to the strengthening of academic freedom, to the enhancement of the University's reputation, to relations between secondary and higher education, or to the shaping of the Wisconsin Idea by which university research was extended to the remote corners and the small communities of the state. We focus this evening, however, on a special dimension of Van Hise's work--that of conservationist and protector of natural resources. It was this special commitment that is believed to have brought the FPL to Madison rather than to Ithaca or St. Paul or Ames.

About the time Van Hise assumed the presidency, Wisconsin was in fact the Nation's leading state in lumber production. Yet, within a few years, public concern soon became alarm over the rapid depletion of forest resources. Van Hise began at just that time to refocus his scholarly interests from geology (in which he had not only taught, but served as director of the State Geological Survey) toward conservation. In fact, the shift marked a natural

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and logical evolution of his boundless energies and creative insight. The first lectures on conservation at this university were given in 1896 and undoubtedly influenced the young geologist. His own fieldwork in northern Wisconsin at the turn of the century sensitized him to the impact of forest depletion on water quality and the environment in general. Thus, the publication in 1910 of his major work entitled The Conservation of Natural Resources came as no surprise to his scientific colleagues. Its modest hope, wrote Van Hise in the preface, was "to serve a useful purpose in forwarding the great movement for conservation which, as it seems to me from the point of the not distant future of the human race, is more important than all other movements before the people." By drawing upon his own lectures and other publications, Van Hise argued in this monograph that the state should assume a far greater role in the development and protection of natural resources--chiefly by regulating both the taking and the use of those resources.

The book and its author had by now attracted national attention in the emerging conservation movement. Van Hise actively and openly supported Gifford Pinchot in public controversy over conservation issues and wrote to President Taft to reaffirm that support. The location of a national laboratory for forest products research coincided happily in time. The choice of Madison as the Laboratory's site may thus have been more a personal than a geographical preference. The successes that followed as the Laboratory matured and grew form the basis of our celebration this evening. Others will have more to say about the later period. As we honor Charles Van Hise for his enduring belief that state universities should serve their citizens by taking research to the farm, the field, and the forest, we should also acclaim his role in bringing to Wisconsin the superb facility which calls us together this evening. No institution better exemplifies the Wisconsin Idea than does the FPL.

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Forestry Research
and Conservation:
An Overview

Peter Myers, Assistant Secretary of Agriculture
for Natural Resources and Environment

U.S. Department of Agriculture, Washington, DC

I'm delighted to be here this evening to join your celebration of the 75th Anniversary of the Forest Products Laboratory (FPL). We can celebrate not only FPL's longevity, but also its productivity, creativity, and commitment to excellence.

Since I was born and raised in Wisconsin and educated here at the University of Wisconsin, this is a homecoming for me--a reunion with that part of my past that shaped my values, knowledge, and career.

The University provided me with an excellent education, and one of the most important things I learned was that I must always keep learning; I must try to stay aware of new research, to use new approaches, to become a better steward of the bountiful land which is a gift from God. So, even though I graduated from the University and left this state, I have not put the FPL behind me. As a farmer in Missouri, as a member of the Missouri Conservation Commission, and in my current position with the Department of Agriculture, I have kept up with your work here. The FPL is doing an excellent job!

The Lord blessed this Nation with an abundance of natural resources, and He entrusted us to care for the land--to ". . . be fruitful and multiply, and replenish the earth . . ." We have more natural resource wealth than some countries can imagine, yet we have seen in the past the damage that can occur to areas not properly managed. We understand the need to use our resources wisely and to manage in ways that increase productivity and reduce costs. Research can be the key that unlocks new techniques in land management, and that key is important to the private landowner, to the Department of Agriculture, and to this Nation.

Research is important to the individual trying to make a living from his land, because the private landowner is finding that old techniques and approaches, not to mention old government programs, are often not enough. I can tell you from my personal experience: research and education are the keys to productive, profitable farming in this country.

Forest Service Research efforts are important to the Department of Agriculture. The Department has an obligation to provide leadership to private land managers, to industrial landowners, and to other government agencies. The results of your research at the FPL are a critical part of redeeming our responsibility as leaders in forestry.

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Your research results are important to this Nation as it competes in the international marketplace. For a long time, we believed no nation on this earth could match America's productivity, but now our position as the pre-eminent producer of goods is being challenged by several countries. I don't know about you, but I like my country to be acknowledged as the world leader, and I for one would like to see this Nation compete successfully in the international arena.

While talking about our position in the international marketplace, many countries still depend on the United States to help them meet their basic human needs. In addition to meeting the needs of the hungry and homeless for today, we must provide them with ways to increase their productivity and lower the cost of technology so they can become self-sufficient in the future.

Much of the work that has been done here can help meet the dual objectives of increasing productivity and lowering costs. There are three ways of reaching this dual objective that I'd like to talk about tonight.

One way is to find new methods of using resources that are abundant. For example, the use of hardwood pulp to make paper--press dry papermaking--can increase our productivity without requiring more production from our land. It lets us use existing productivity wisely.

Another way to increase productivity and lower costs is to increase the durability of wood products. If wood products last longer, we can maintain a sustained harvest of timber while meeting more needs. If the products last longer, assuming the cost is a constant, the prorated cost per year is less. Your work here with wood-protecting chemicals and finishes, and your work with termite control, improves the durability of wood products. That lets us use our resources wisely.

A third way to increase productivity and reduce costs is to find ways to do more with less. An example of this is the trussed-frame system that is already being used in construction with excellent results. If we can build a better house with less wood through innovative construction techniques, we can make housing more available. And, of course, this technique is not limited to residential construction, but includes commercial construction too.

I realize that research that broadens our knowledge is important, but in my role as Assistant Secretary I see the need for government research programs to produce results that can be applied by individuals outside the laboratory--that can solve problems of increased demands on our resources. In short, we need to know how to grow forests faster and use them better. Your work aims toward those needs, so your work is essential to our prosperity as a Nation.

Another area of interest concerns legislative initiatives to assist the land managers, especially the farmers. So, I'd like to talk briefly about the 1985 Farm Bill. This is a topic of great concern to me and Secretary Block and the President as well.

Through well-intentioned support programs, including technical and financial assistance, the government has encouraged farmers to expand production acres.

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Some farmers, stimulated by support programs, started "sodbusting" delicate western rangeland, draining wetlands, and clearing forests to "cash in" on the federal largess. At the same time new ground was being put into production, the government employed production controls, acreage controls, and commodity reserves to keep a cap on the quantity of some products reaching the market. This dual approach encouraged the rise of a monstrously inefficient and sometimes environmentally unsound farm program.

Our nation is emerging from a difficult economic period. Worldwide recession and a strong American dollar have caused an economic crisis in agriculture, forestry, and some other segments of society. Our current economic recovery includes a modest, stable rate of inflation that encourages productive growth. I believe the current recovery can and must include the farmer, and this Administration is working for agricultural legislation that will end counter-productive programs and start programs that will truly benefit the farmer.

We want a farm bill that will position rural America for future growth, but we can't just "pull the rug out" from under farmers. The final farm bill legislated by Congress must provide for a gradual transition from old to new programs to insulate the farmers from abrupt change.

The farm bill must be market-oriented with a reduced role for the government. It must have loan levels that cause farm commodities to move into the marketplace, not into government storage!

It must enhance our competitive strength in international markets and incorporate long-term policies that will guide us through the turn of the century.

Secretary Block has worked hard to get a solid budget and specific positive features in the agriculture legislation package, including a conservation reserve program. We have proposed a conservation reserve program that will, for a period of 10 years, take 20 million acres of highly erodable cropland out of production. It contains a strong "sodbuster" provision, which would deny federal farm program benefits to operators who begin tilling soils with a high potential for erosion unless they are following a plan approved by the local conservation district. We want to send an unmistakable message to those "sodbuster" operators that the federal government will no longer finance their operations.

Encouraging landowners whose land is poorly suited for crop production to manage their land for other benefits makes good sense. However, most of these landowners will need guidance. They'll need professional resource managers to show them how to manage their land for multiple benefits. They'll need to know how research can help them plan the future use of their land. At the state, local, and federal levels, we must provide answers to their questions regarding proper, productive use of the land.

This goes back to a statement I made earlier: it's important to stay aware of new reserach and to use new approaches. I think a lot more farmers will share this perspective in the next few years.

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Of course, after we have developed new products or new techniques, we must transmit the new technologies to potential users. Quite often industry and private operators in other countries are the first to use techniques developed here in Madison. We can't afford to lag behind, so that's another challenge we face--technology transfer.

Our knowledge of resource management has grown and some of this knowledge can make for more cost efficient and environmentally sound land management. Conservation tillage, for example, is cost efficient and we know how to use it properly, but we must convince more farmers that it's to their advantage to use this method. We have increased our knowledge of biological pest control methods, and we have developed fastergrowing insect- and disease-resistant trees. Now we have to help educate potential users.

My preacher in Missouri says, "We've got to go out and spread the Good News." Of course, he means the Gospel of the Lord, but we've got some good news too that must be spread. Progress that has been made because of research needs to be taught with the fervor of an evangelist. We have a responsibility to use wisely God's gifts to us. And it's not enough to manage our natural resources wisely just for our benefit. We have a responsibility to future generations to give them a world in which they can prosper. We're making good progress in shaping a world that is more prosperous, but we have much more to do.

We have serious problems such as atmospheric deposition that harm our environment. Bob Buckman, Deputy Chief of Forest Service Research, is marshalling forces to learn more about the problem of atmospheric deposition that threatens the well-being of future generations. Some of our progress in farming and forestry has come with a price tag we can't truly afford; progress on one front creates dilemmas on another front, and so we must research new ways to solve old problems as well as new.

Forestry, and all types of farming, require not only a love for the land, but also some knowledge of science and business. Land managers are really in the business of converting energy--the sun--to usable food, fiber, and fuel for man--to improve the quality of life. That often requires the wisdom of Solomon and the patience of Job.

Well, I've covered a lot of territory in the past few minutes. From my days in Madison, to the importance of the work being done here, to our agriculture legislation efforts, to the need for technology transfer and the importance of continuing research. It's a good thing my topic was far reaching or some people might accuse me of rambling. But the topic is far reaching, and the future is exciting. I am hopeful that agricultural and forestry research will be the topic of an Agriculture Yearbook in the near future. When such a book is written, the FPL will surely be mentioned with pride!

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The Laboratory
and the University:
A Continuing Partnership

Irving Shain, Chancellor

University of Wisconsin, Madison, WI

Thank you for the honor of sharing this anniversary event with you. This occasion offers an opportunity to acknowledge the accomplishments of the Forest Products Laboratory (FPL). Since its founding, the FPL has developed a comprehensive program that has certainly lived up to--and in many ways surpassed--the ideas and dreams of those who worked so hard to establish it 75 years ago.

As most of you know, the fact that we are here, in Madison, celebrating this anniversary was not without its original uncertainties. If some of the political maneuvering that was going on in 1908 and 1909 had taken a slightly different tack, we could very well be observing this occasion in Ann Arbor or Minneapolis. It was only through the influence of President Charles R. Van Hise that the University of Wisconsin was able to withstand the challenges of the universities of Michigan and Minnesota and prevail as the preferred site of the FPL.

Wisconsin had been initially selected as the site for the Lab, but political pressure by a Michigan congressman forced a reconsideration of the original decision. Forester Pinchot, in an effort to make sure that the beginnings of the Lab were free from political taint or controversy, directed that a comprehensive review of potential sites be conducted and, in the process, invited the University of Minnesota to make a proposal.

After substantial review and following persuasive arguments by President Van Hise, this University was confirmed as the site for the new laboratory. Formal announcement of the selection was made on March 5, 1909, by Secretary of Agriculture James Wilson, and the Laboratory was officially opened during special ceremonies held on June 4, 1910. The Laboratory was housed in a new facility built by the University and the State of Wisconsin and located on University Avenue adjacent to the railroad tracks. This building, which is still a prominent part of our Engineering Campus, currently houses the Department of Metallurgical and Mineral Engineering.

It is important to recognize why Madison ultimately prevailed as the site for the Lab. As historian Charles Nelson has pointed out, "Wisconsin won the laboratory because of Madison's location and because of the University's excellent reputation for practical scientific research."

There was another crucial factor--leadership. Just a few moments ago, we heard tributes to two remarkable men--Gifford Pinchot and Charles R. Van Hise.

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As was pointed out, these men were remarkable because of their accomplishments and their personal vision. Pinchot and Van Hise were men on horseback, in both a literal and figurative sense. Pinchot, of course, is remembered for his love of being on the trail, of leading horseback caravans through the American wilderness as he pointed out the need to preserve this irreplaceable national asset.

Many of the photographs of Van Hise we have in our University Archives show him on horseback as he goes about his business of administering the University. Van Hise, as we know, did not need to rely on the use of a horse to rise above the crowd.

Pinchot and Van Hise shared a vision. They felt it was essential to maintain an appropriate balance between nature and civilization. Both campaigned vigorously for the preservation of our natural resources--Pinchot through his work as founding director of the Forest Service and Van Hise through the publication of his influential book, The Conservation of Natural Resources.

Pinchot and Van Hise recognized that we were at a pivotal point in our national history during the opening years of this century. They realized that, without proper constraint and management, the forward march of industrial development could irreversibly deplete our natural resources. Bold steps had to be taken to prevent this from happening. Enlightened government had to act on behalf of the people before irreparable damage had been done.

While each man pursued his particular remedy for the problem, both agreed that a program of research was a key element in advancing the cause of conservation.

The initial cooperative agreement between the Lab and the University is instructive for what it says about this point. Lab facilities were to be available to graduate students; staff members of the Lab would, on occasion, deliver lectures at the University; and publications issuing from the Lab would give credit to the University as the cooperating agency.

Both Pinchot and Van Hise recognized that the organizational structure of a university was compatible with the purposes of the Lab. This pattern has emerged quite distinctly as the Lab has matured and expanded its research to accommodate the influences that new knowledge and technology have had on the study of wood and wood products.

Throughout its history, the accomplishments of the Lab have been impressive. These developments have been the fruits of both basic and applied research. Even though it may seem slightly redundant at this point in our program, let me review some of these noteworthy accomplishments:

-- the development of steaming and bending processes to aid in building and furniture construction,

-- the perfecting of lamination techniques and the development of improved adhesives and bonding technology,

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-- advances in wood preservation, pulp and paper technology, and packaging technology,

-- discoveries relating to obtaining energy from wood,

-- expansive research in wood anatomy and identification,

-- the publication of such important volumes as the Wood Handbook, Tropical Timbers of the World, and The Chemistry of Solid Wood,

-- and, perhaps the most significant of all, the promotion of a greater understanding of what is needed to maintain a sensible management of our renewable resources.

The continuing story of the relationship between the Lab and the University is a refreshingly positive indication of progress through cooperation. Earlier I mentioned important provisions in the original agreement between the Lab and the University. This was just the beginning of a partnership that has been constant and constructive through many periods of development and change.

Scientists from the Lab provided the initial instruction in forestry topics for our College of Agriculture. This extended from 1927 until 1942 when a Department of Forest Products was established. The Lab, through the presence of R. L. Youngs, our master of ceremonies this evening, helped formulate plans that led to the establishment in 1971 of the first accredited baccalaureate forestry program in the state at the UW-Madison.

The cumulative record of ties between the Lab and the University is impressive. A recent accounting reveals that nearly 300 theses have been completed by FPL staff members at the UW-Madison during the past 75 years. Cooperative relationships between the Lab and the University have extended to nearly 25 academic departments and research facilities. Many cooperative outreach projects have been initiated with UW-Extension. The cooperation continues with a total of 441,000 federal dollars currently funding 18 research agreements on the campus.

As the relationship between the Lab and the University has matured, it has been instructive to observe the progress of the University's commitment to forestry education and research. The first effort involved the establishment of a 2-year program to train forest rangers. Although this initial effort lasted for only 2 years, from 1913 to 1915, it was later revived in a different form with the initiation of a "Junior Forest Rangers" program in Extension under the direction of Wakelin McNeel, who became familiar as "Ranger Mac." His radio programs, broadcast on the "School of the Air" over WHA, taught generations of Wisconsin school children the need to respect and maintain our forest resources.

The University became formally involved in forestry research with the appointment of a forest extension specialist in 1925. Dean of Agriculture Harry L. Russell was instrumental at this time in stimulating the development of a school forest program throughout the state. This program currently includes more than 300 local school forests. These facilities continue to

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provide Wisconsin school children and interested citizens with opportunities to learn the techniques involved in the proper management of our woods and forests.

Fifty years ago, the University established a preforestry program to provide training to students who eventually would go on to complete forestry degrees at fully accredited institutions in other states.

The University produced an important technological contribution to forest management in the 1940's when researchers in the Department of Agricultural Engineering perfected a mechanized tree planter. This device generated a considerable advance in productivity for Wisconsin's forest industry.

Although Wisconsin did not yet have a school of forestry, steps were being taken to increase the University's commitment to the preparation of professional foresters. A Department of Forestry and Wildlife Management was established in 1954, and in 1962 a separate Department of Forestry was approved. Progress continued in the 1960's with the creation of a School of Natural Resources within the College of Agricultural and Life Sciences. This paved the way for the development of an undergraduate Forest Science curriculum in 1971, giving the UW-Madison, as I mentioned earlier, the first accredited forestry program in Wisconsin. This program is now fully functioning as one of 44 institutions accredited by the Society of American Foresters. It graduates approximately 25 students each year and receives consistently high rankings for the quality of its offerings.

At the same time our instructional program has grown, faculty research productivity has been at or near the top during the past several years. In addition, our Forestry faculty has worked with 32 different Wisconsin forest industries, with state and national government agencies, and with 29 forest industries in 18 other states and 12 foreign nations.

If the Lab and the University are to continue their collateral development to extend the productive partnership that has characterized our past relationship, we must be aware of these several needs:

First, it is essential to understand how technology and the rapid growth of information influence scientific development. The Lab's record of technological innovation has been outstanding. If you study closely the Lab's accomplishments, you will find that FPL scientists were at the forefront in utilizing state-of-the-art technology to improve the treatment of wood and wood products. A similar awareness has characterized the progress of research at the University. We have an admirable record in this area, but we need to sustain our ability to utilize technology and information to produce further discoveries and innovation.

Such development is contingent on our ability to train, recruit, and maintain outstanding scientists and scholars. The distinctive reputations of the Lab and the University are due to those special individuals on both staffs who have the talent, drive, and imagination to make new discoveries and to solve practical problems. To continue our leadership, we must carefully nurture our staff members and provide them with the opportunity to do the best work they are capable of doing.

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We also must encourage additional cooperation between our two institutions and the forest industries. In recent years, we have come to appreciate the high degree of professionalism demonstrated by scientists and administrators in our forest industries. They offer direct assistance in translating the findings of research into practical applications.

If the Lab and the University are to move forward together, we must maintain and expand upon the ideals of Pinchot and Van Hise. The inherent wisdom of their original vision has endured for these past 75 years. We need to rededicate ourselves to a continuing cooperation as we seek to maintain that essential balance that assures both progress and preservation.

In that context, there is another voice that needs to be celebrated this evening, that of Wisconsin's most eloquent ecologist--Aldo Leopold. Let me use this meditation from his "Round River" essay as a final means of honoring the legacy of Pinchot and Van Hise:

"Conservation," Leopold noted, "is a state of harmony between men and land . . .

"The outstanding scientific discovery of the twentieth century is not television, or radio, but the complexity of the land organism. Only those who know the most about it can appreciate how little is known about it. The last word in ignorance is the man who says of an animal or plant: 'What good is it?' If the land mechanism as a whole is good, then every part is good, whether we understand it or not. If the biota, in the course of aeons, has built something we like but do not understand, then who but a fool would discard the seemingly useless parts. To keep every cog and wheel is the first precaution of intelligent tinkering."

Leopold's concept of intelligent tinkering reflects a sensitivity that should be the watchword in the continuing cooperation between the FPL and the University.

The 75-year record of accomplishment we are celebrating tonight represents an impressive beginning, but we still have work to do. I am confident that we can continue to enlarge and build on the record of past accomplishment.

On behalf of the University community, I would like to extend my congratulations to the staff and leadership of the FPL on this special occasion. You can be proud of your distinctive contributions. Your institution is essential to America's future. And we in the University cherish you as an essential element in our teaching, research, and public service programs.

Thank you again for the opportunity to be with you this evening.

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